Symptom appraisal in uncertainty: A theory-driven thematic analysis with survivors of childhood cancer

Running head: *Symptom appraisal in uncertainty*

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ABSTRACT

Objective: Somatic symptoms capture attention, demand interpretation, and promote health behaviors. Symptom appraisal is particularly impactful within uncertain health contexts such as cancer survivorship. Yet, little is known about how individuals make sense of somatic symptoms within uncertain health contexts, nor how this process guides health behaviors.

Design: 25 adolescent and young adult survivors of childhood cancer completed semi-structured interviews regarding how they appraise and respond to changing somatic sensations within the uncertain context of survivorship.

Main Outcome Measures: Interviews were transcribed verbatim and subjected to a hybrid deductive-inductive thematic analysis, guided by the Cancer Threat Interpretation model.

Results: Theme 1 ('symptoms as signals of bodily threat') captured that participants commonly interpret everyday sensations as indicating cancer recurrence or new illness. Theme 2 ('playing detective with bodily signals') captured the cognitive and behavioral strategies that participants described using to determine whether somatic sensations indicated a health threat. These two themes are qualified by the recognition that post-cancer symptoms are wily and influenced by psychological factors such as anxiety (Theme 3: 'living with symptom-related uncertainty').

Conclusions: These data highlight the need for novel symptom management approaches that target how somatic sensations are appraised and responded to as signals of bodily threat.

INTRODUCTION

Somatic symptoms are among the most distressing aspects of illness, the most common reasons for seeking healthcare, and the most feared parts of treatment. In short, somatic symptoms are central to our experience of health and illness. Somatic symptom appraisal is particularly important in the context of an ambiguous and uncertain health threat, where symptoms capture attention and provide information about the state of health, thereby driving health-related and healthcare-initiating behaviors. Yet, symptoms do not provide a direct read-out of the state of body tissues. From an evolutionary perspective, somatic symptoms such as pain, itch, nausea, and breathlessness act as conscious signals to protect us from actual *or potential* bodily threat, thus promoting protective behaviors even in the absence of underlying pathology (Eccleston, 2016; Wall, 1979). In the context of a possible or probable health threat (e.g., new or recurrent illness), it can be adaptive to be vigilant for new and changing somatic sensations and to appraise these sensations as threatening (e.g., as symptomatic of illness). However, these attentional and interpretational biases (also known as cognitive biases) may distort the salience and nature of somatic sensation, increasing the risk of an inappropriate behavioral response (e.g., under- or over-utilization of healthcare). Drawing from research particularly in post-traumatic stress disorder (PTSD) (Conoscenti et al., 2009; Forbes et al., 2019), a prolonged state of heightened vigilance and perceived threat may also decrease health and wellbeing by promototing maladaptive coping and by increasing stress, anxiety, and negative affect over time. The longer-term deleterious consequences of symptom vigilance are particularly applicable in the context of a prolonged health threat, for example the possibility of disease recurrence over months or years.

Cancer survivorship is one such uncertain health context, entailing varied and time-dependent risk of disease recurrence and treatment sequelae. This uncertain context is particularly

pertinent for survivors of childhood cancer, who face a lifetime of health- and symptom-related uncertainty (Oeffinger & Robison, 2007). Indeed, 5- and 10-year survival rates for childhood cancers have doubled over the last 40 years, with 80% of children now surviving their disease (Ward et al., 2014). Today, there are over 400,000 survivors of childhood cancer in the United States alone. Yet, childhood cancer survivors will experience an average of 17 chronic health conditions by the age of 50; almost twice as many as their healthy peers. Most face a lifetime of risk for physical and psychological health challenges, including cancer recurrence, leading to decades of healthcare use (Hudson et al., 2003). In addition, childhood cancer survivors face both age-typical bodily changes (e.g., physical growth, hormonal maturation) alongside elevated risk for frailty and accelerated aging (Henderson et al., 2014), both of which cause profound and complex changes in somatic sensation and bodily state. Survivors of childhood cancer therefore are a clinical population with both significant symptom-relevant healthcare needs and from whom we can learn a great deal about how symptom appraisal influences health and wellbeing within an uncertain health context.

To date, a small number of *quantitative* studies indicate that somatic symptoms, particularly pain and fatigue, are prevalent and burdensome in adult survivors of childhood cancer (Huang et al., 2013; Lu et al., 2011; Miser et al., 1987). These studies also reveal that symptom burden is associated with elevated fear of cancer recurrence (Kelada et al., 2019), a primary and impactful psychosocial issue in this population. Yet, quantitative studies do not yet indicate the mechanisms through which symptoms and fear of recurrence interact, nor how this interaction influences health outcomes. We know almost nothing about how childhood cancer survivors attend to, interpret, and respond to somatic sensations within the uncertain threat of disease recurrence and new illness. Qualitative methods offer a valuable tool to guide theory advancement and

hypothesis generation in a relatively new health research field (Braun & Clarke, 2014, 2019b). Gaining idiographic rather than nomothetic accounts of the triggers, mechanisms, and consequences of symptom appraisal through the lens of the young cancer survivors' perception of their unique health vulnerabilities will be essential to developing appropriate symptom perception measures and targeted psychosocial interventions.

The majority of extant qualitative research in cancer populations is inductive in nature. For example, research using semi-structured interview schedules commonly asks patients to describe their general experiences of cancer diagnosis, treatment, or survivorship, with the intent to assess shared needs. Yet, there has been substantial theoretical development in psycho-oncology over the last 10 years, particularly within the study of fear of cancer recurrence (Sharpe et al., 2017). These advancements offer frameworks and models that can aid a complementary, more deductive approach. Hybrid deductive-inductive approaches are particularly well suited to situate analyses within established theoretical frameworks while still gaining novel insights from the resultant data (Fereday & Muir-Cochrane, 2006). Particularly relevant for understanding symptom appraisal in the context of cancer survival is the Cancer Threat Interpretation (CTI) theoretical model (Heathcote & Eccleston, 2017). The CTI model offers a cognitive-affective account of pain appraisal within the uncertain threat of cancer recurrence. It pinpoints cognitive (attentional vigilance, threat interpretation, worry) and affective (fear) factors that can influence post-cancer pain and provides a potentially fruitful coding framework for qualitative data. Although initially conceptualized for understanding pain perception, the CTI model can be applied to understanding symptom perception more broadly within the context of both cancer- and health-related uncertainty (Heathcote et al., 2018).

The primary objective of this study was to combine the CTI model (Heathcote & Eccleston, 2017) with a flexible qualitative method (reflexive thematic analysis; Braun & Clarke, 2019a) to gain novel and hypothesis-generating insights into the way that survivors of childhood cancer perceive and respond to somatic sensations while living with health-related uncertainty. Of note, we have previously recognized the value of using the term 'sensation perception' rather than 'symptom perception' in research, to distinguish the felt experience from the attribution (Heathcote, 2019). Here, we flexibly use both terms to reflect that the term 'symptoms' is in common language use by both individuals with cancer and those who treat them, thus aligning our overarching goal for this qualitative work to be patient- and person-centered.

MATERIALS & METHODS

Study Design

This paper analyzes qualitative data generated through in-depth semi-structured interviews of adolescent and young adult survivors of childhood cancer (hereafter referred to as 'childhood cancer survivors'). Interviews focused on the topic of symptom and bodily perception within the context of cancer survival. The research question for this paper was as follows: **how do childhood cancer survivors make sense of and respond to changes in somatic sensations during survivorship?** Our overall approach is situated within a 'Big Q' qualitative framework (Braun & Clarke, 2013), focusing on a small clinical sample to generate deep, rich insights into individual experiences. This approach acknowledges the researchers' expertise and motivating theoretical frameworks as a valuable part of analytic knowledge production. This approach is set in contrast to a 'small q' orientation where coding concerns (e.g., reliability, avoiding bias, generalizability) stem from a 'scientific' positivist-empiricist quantitative orientation. Thus, our approach is

purposefully hypothesis-generating and theory-expanding rather than hypothesis- or theory-confirming.

Participants

Participants were recruited from the Bass Center for Childhood Cancer and Blood Diseases. Participants aged 15 – 25 years were eligible to participate if they 1) were previously diagnosed with any cancer and 2) had finished curative cancer treatment more than one year previously. Participants were not eligible to participate if they 1) were unable to read and write in English or 2) had significant cognitive impairment. We purposefully over-sampled participants with a history of sarcoma and leukemia due to data indicating higher symptom burden in these populations [e.g., pain and fatigue; (Lu et al., 2011; Meeske et al., 2005; Mulrooney et al., 2008)]. We contacted 46 childhood cancer survivors; 25 agreed to participate (see Table 1). This sample size is consistent with best practices for thematic analysis (Braun & Clarke, 2013). Reasons for nonparticipation were: lack of response to contact (n = 16), not appearing for the interview (n = 2), declining to participate (n = 1), or not consenting to audio recording (n = 1). The study protocol was approved by the Stanford Medicine Institutional Review Board.

Procedure

Participants took part in individual semi-structured interviews with one or two members of the research team (NL and/or LCH). Interview schedules (see supplemental materials) were developed by LCH and NL and revised with feedback from AJ. Prior to each interview, informed consent was obtained from participants aged 18 or older; informed assent and parental consent was obtained from participants aged 17 or younger. Interviews were performed either in person in a private meeting room (n=12) or via video call (n=13). Video calls are commonly used in qualitative research and provide a viable alternative where in-person methods are not possible (e.g., where

patients live far from the clinic) (Iacono et al., 2016). Interviews ranged from 23 to 62 minutes (*Mdn* = 46 minutes), were audio-recorded on two digital devices, and transcribed verbatim. The data that support the findings of this study are available from the corresponding author, LCH, upon reasonable request.

Analysis

Analysis followed Braun and Clarke's reflexive thematic analysis method (Braun & Clarke, 2006, 2013, 2019a). This qualitative analysis method emphasizes flexibility in identification and interpretation of patterns within the data. Our analysis focused on both semantic and latent features of the data, considering both what the participants said (i.e., content and meaning) and how they said it (i.e., language use). We used a hybrid deductive-inductive analytic approach (see also Fereday & Muir-Cochrane, 2006). Specifically, we first deductively generated codes from the Cancer Threat Interpretation (CTI) theoretical model (see Figure 1), including codes for 'threat interpretations', 'biased attending', and 'fear and worry'. Additional codes and resultant themes were inductively developed from the data content.

Following the six steps outlined by Braun and Clarke (Braun & Clarke, 2013), the primary coder (NL) first familiarized herself with the data through reading and re-reading transcripts while recursively coding the data, using NVivo version 12 (*NVivo Qualitative Data Analysis Software*, 1999). Codes were then clustered together into candidate themes to give some indication of their prevalence and test their value in giving an overall account of the data. Five candidate themes were identified which were then collapsed into three themes to avoid considerable theoretical overlap. Coding and theme development were supervised by iterative feedback from LCH (author of the CTI model) and AJ (a researcher with over 14 years of experience in thematic and other qualitative analyses). In line with a 'Big Q' approach, collaborative theme development was used to develop

a richer more nuanced reading of the data rather than to seek a consensus on meaning. Themes were developed to represent patterns of shared meaning underpinned or united by a core concept, rather than domain summaries. Braun & Clarke's criteria for demonstrating the quality of thematic analysis were met (Braun & Clarke, 2013). This included the following: 1) detailed transcriptions were checked against audio recordings for accuracy, 2) equal attention was given to each data item in the coding process, 3) a balance between data (i.e., quotations) and analytic narrative, 4) most participants were represented with one quotation; no participants were represented with more than three quotations, and 5) the researcher was positioned as active in the research process.

RESULTS

We generated three salient themes related to participants' appraisals of and responses to somatic sensations in the context of living with health-related uncertainty. Excerpts of transcripts are provided below as examples of each theme and were selected to illustrate both the central components of each theme and the breadth and diversity of perspectives.

Theme 1: Symptoms as signals of bodily threat

The first theme captures that somatic sensations during survivorship are often appraised as signals of bodily threat. Pain was commonly mentioned as a particularly salient signal of threat, especially if it mirrored pain experienced at initial diagnosis or in the previous tumor site.

> *Like pain was just like something – especially in like a similar area – I was just super paranoid and I would actually not be able to focus on my school work at all. Like I would just like keep thinking about it like, 'oh my gosh am I okay? What do I do?'* – P10, Ewing Sarcoma

Besides pain, participants described interpreting a range of different somatic sensations as indicating bodily threat, including "*fatigue*" (P14), "*tingling*" (P20), "*nausea*" (P16),

"*lightheadedness*" (P25), and being "*on the verge of passing out*" (P2), as well as more tangible changes in bodily state such as "*fevers*" (P11), going visibly "*pale*" (P17), and "*lumps"* (P22).

Most commonly, the perceived 'threat' focused around the cancer returning.

> *I have a headache! Does that mean my tumor's back or does that just mean I have a headache?* – P4, Brain Tumor

Some participants described that while they would not worry about a single symptom, they would be concerned about a "package" of symptoms.

> *If I had like a headache, I wouldn't particularly attribute that to like having like, being diagnosed with cancer again. […] If there's a huge, severe package of like symptoms or like of problems that I was suffering from, then I would maybe […] go to a doctor.* – P21, Burkitt's Cell Leukemia

For several particiapants, the fact that the initial symptoms were ignored for so long elevated the felt need to interpret future sensations as threatening. In other words, they applied a 'better-safe-than-sorry' strategy to interpreting and responding to post-cancer symptoms.

> *Because like one big mistake we made, right, was like at the time of diagnosis we didn't like take the pain seriously as we should have the first time and we kinda let it sit and wait. So yeah, I'm a lot more cautious about like kind of checking these things out as soon as they arise.* – P23, Osteosarcoma

Yet, for others, the *lack* of symptoms at diagnosis led to the appraisal of sensations as threatening during survivorship.

> *For me the lack of symptoms that I had initially is terrifying. Cause I can have anything going on in my body and I would have no idea. If I feel pain or if something doesn't feel right [long pause], sometimes I overanalyze that.* – P9, Wilms' Tumor

The diversity in these perspectives speaks to the question of how symptom experiences during and after cancer treatment influence and are influenced by the mindsets that young people hold about their bodies. Particularly, whether they view their body as something that can be 'trusted' to provide accurate information about the state of body tissues, or as a saboteur that is secretly working against them and silently spreading or not mitigating disease (Zion et al., 2019).

Beyond cancer recurrence, participants also described interpreting sensations as indicating other potential health threats. This commonly included fears of late effects from their treatment.

> *I'm not afraid of cancer, I'm afraid more like of bone death […]. Sometimes like, your shoulder hurts or like your knee hurts and you just associate it with like bone death cause that's common between people who get a transplant.* – P11, Acute Myeloid Leukemia (AML)

Other participants talked about symptoms as signals of poor health more generally, speaking to awareness of risk for long-term chronic treatment sequalae in this population.

> *I do go to the side of worrying [about sensations], but not cancer […]. I think of it being related to the past, which I did have cancer but not necessarily that it's the cancer coming back. It's more like the side-effects of the chemo or me being susceptible to more things.* – P14, AML

Regardless of whether sensations were interpreted as cancer, late effects of treatment, or poor health more generally, there was variation in how immediate this threat seemed to participants. To some, the first thought was a fleeting 'what if it's cancer?' that was quickly dismissed.

> *[With pain] it just kinda quickly flashes to like {snaps}, 'what if it's cancer?'. But like, I don't really dwell on it for too long.* – P20, Acute Lymphoblastic Leukemia (ALL)

For other participants, threat interpretations were described as 'moments' in time. While the initial interpretation was more benign (e.g., a result of better eating and exercise), the threat interpretation would later emerge as a 'what if', that could then cause sudden alarm.

> *Every now and then maybe I would have a moment of like, 'oh my gosh I am feeling tired again, what if it's the cancer?'. Or like I think I randomly like, had lost some weight. I think it had more to do with eating better and moving more and not being so tired all the time that I could like resume normal exercise – but I think I was like 'wait a second I remember, lymphomas, one of the potential indicators you have it is weight loss'. So I was like, 'holy cow like what if I'm suddenly losing weight cause the cancer's actually back?' So, every now and then I will have sort of like this like momentary fear.* – P12, Non-Hodgkin Lymphoma

For other participants, threat interpretations seemed almost ubiquitous and were described in terms of an immutable, conditioned connection between symptoms and cancer.

> *You just associate everything with cancer, right? […]. Your mind always goes to like a negative, with everything, really. You always think the worst.* – P11, AML

For one participant, this deep conceptual connection between symptoms and cancer appeared to relate to a tendency to interpret 'every' new symptom as a potential threat. The explicit language use (**bolded**) exemplifies the extreme nature of the individual's fear.

> *I can't stop the association of physical pain with being scared of cancer coming back. I feel like they're tied together. Every time I like have a physical pain I'm like, 'Oh **f**k**!'. Every time I feel short of breath I'm also like, 'Oh **f**k**!'.* – P7, Osteosarcoma

Related to this portrayal of an immutable connection between symptoms and cancer is another participant's description of being in a "*constant state of vigilance ever since I was sick*" (P4, brain

tumor). For some participants, this perceived need to be vigilant for possible symptoms of cancer or late effects was reflected in an active monitoring and scanning of their bodies.

I'm just constantly looking out for [changes in breathing or heart rate]. – P24, Osteosarcoma

For others, the need for vigilance resulted in a more behavioral response, particularly body checking behaviors. Whether described as cognitive or behavioural processes, the presented quotations reflect the felt need for participants to pay increased, sometimes excessive attention to their bodies and the somatic sensations therein.

And so, for me, I'm always feeling for lumps and if something hurts in a really weird way I have to figure out why. – P9, Wilms Tumor

Taken together, this first theme captures that participants described a felt need to be vigilant for post-cancer somatic sensations and to appraise these sensations as signals of bodily threat, presumably as part of a 'better safe than sorry' strategy to mitigate the possibility of missing a recurrence of their cancer or a future illness, and thus to promote future health.

Theme 2: Playing detective with bodily signals

As a result of being vigilant for and noticing new sensations, participants commonly described feeling a need to 'play detective' to try to determine whether or not their sensations indeed indicated a credible health threat. This second theme captures the cognitive and behavioral strategies that participants described using to guide their response to new and changing sensations.

Participants described applying various cognitive heuristics to attempt to assess the threat level of their sensations. One such heuristic was the 'duration' rule:

If [pain]'s been happening for like a day and then it goes away then you know it's okay. But if it's like – it's like very bad and it's happening for like two or three days then I'll probably tell [the doctors]. – P25, ALL

As evident in the quote above, several participants mentioned that they tried to assess how 'bad' a sensation was, and whether the severity of the sensation appeared to be excessive and whether it impacted their everyday life (i.e., a 'severity of interference' rule).

So sometimes if I'm feeling like extra winded or like I'll have like a heart palpitation […], if I'm like tired and it's like I walked not that far and I'm like really tired I'm like 'oh my – am I OK?'. – P24, Osteosarcoma

Another commonly described cognitive heuristic was the 'pattern rule', particularly assessing whether the sensation went away and came back or intensified over time.

If it's just there and it disappears I'll be like, 'okay whatever.' But if it's like it's there and it's not, it's there and then not, I'm like, 'okay what is this!'. – P10, Ewing Sarcoma

For others, the *quality* of the sensation was considered central. The language use in the following quote (captured in **bold**) indicates that distinguishing sensations based on their quality was not an exact science, but represented more of a best guess.

*I've gotten to the point where I can **kind of** recognize like what a normal pain is versus like what is something that could be a little bit alarming, so that a normal pain would kind of be like an achiness, soreness. Something that would be more worrying would be **kinda like** a sharp pain **or something**.* – P23, Osteosarcoma

Participants described playing detective in their search for alternative causes of their symptoms.

I had an idea that [the rash] was environmental cause like I probably needed to do laundry for my sheets like that was… the most logical explanation. P18, Hodgkin Lymphoma

For some, their language use (**bolded**) reflected that this search process was active and effortful.

> *I **try to figure out** why something hurts. For example, if my legs hurt but I also like walked three miles the day before I'm like, 'ok'. […] I **do** a lot of tracing back of what I've done and **figure out** why so that's a lot of where my worry **energy** goes and figuring out why this is happening.* – P7, Osteosarcoma

If an alternative cause was not immediately apparent, participants described attempting behavioral experiments, including taking over the counter medication or pushing their body to test if their symptom translated into a functional decline.

> *When you're feeling faint or your energy levels are low and you can do something about it, you can like basically run it like a small test on yourself, you know let me just get up and… drive somewhere or walk somewhere or do something it's almost like a test to myself like 'okay like I'm able to do it, I'm just lazy, I don't want to do it'.* – P19, AML

When faced with a symptom of concern, some participants described seeking reassurance from others, including parents. Others found comfort in the the recency of medical surveillance tests, indicating that symptom-related distress may follow a waxing-and-waning pattern in between follow-up visits.

> *I started feeling a little more lethargic for whatever reason and I sorta like in the back of my head I was like, 'oh wait like – no I just had a blood test and like it showed up everything was fine so like it's not – it's not the cancer, like that's ridiculous'.* – P12, Non-Hodgkin Lymphoma

In addition to routine surveillance, participants sometimes described seeking additional reassurance from healthcare providers, which occasionally resulted in additional tests or scans. These data provide valuable insights into how symptom appraisal guides healthcare-seeking behaviors in this population.

If I didn't get checked out it would just drive me crazy… I asked my mom about it and if it goes on for more than five days she'll just be like, 'alright we need to call the doctor cause you're not going to stop psyching yourself out until you hear from them.' – P8, Osteosarcoma

Finally, while healthcare providers often provided a source of support and reassurance for new symptom-related concerns, it is important to acknowledge that some participants described their perceived need for symptom vigilance as stemming from the messages they received from the healthcare team. A clinical instruction to be vigilant for signs of recurrent or new disease, while well-intentioned, may inadvertently evoke symptom-related fears.

I was pretty nervous just because it [the symptom] is something they always tell you about like 'make sure you're checking for these symptoms' and that was one they told me to look for so I got really worried. – P22, T-Cell ALL

Taken together, the quotations in this theme highlight a wide range of strategies that participants described using to determine whether or not a sensation is threatening and how to respond to it. These strategies were influenced by medical surveillance and in some case included seeking additional surveillance tests, indicating the role of the healthcare team. Similar cognitive heuristics have been identified in quantitative work with adults who sought help for potential symptoms of cancer (Kummer et al, 2019). Overall, participants' felt need to play detective with their bodily signals appeared effortful and sometimes energy-consuming, potentially indicating a mechanism through which the experience of somatic symptoms may increase fatigue in this population over time. The range and heterogeneity of the detective strategies that participants described also highlights a reality of cancer survivorship – that making sense of post-cancer sensations entails managing a great deal of uncertainty. This uncertainty is captured in our third and final theme.

Theme 3: Living with symptom-related uncertainty

The final theme captures the uncertainty that participants described feeling around how to appraise and respond to somatic sensations after their cancer experience. This uncertainty was described as a recognition that post-cancer somatic symptoms are wily, unreliable, and influenced by psychological factors such as anxiety. In some ways, this final theme represents that a meta-awareness of post-cancer symptoms as conscious signals of bodily threat, shaped by biopsychosocial factors rather than directly representing the state of body tissues.

> *I'll be kind of like, […] thinking about [the sensation], kinda testing it. […]. Maybe I'm pretending, maybe I'm not pretending, I just don't know. It's hard to trust yourself because you don't know what you're making up and you don't know what's real.* – P24, Osteosarcoma

Like for P24, some participants described perceiving symptoms as something their brains could be 'making up', rather than reflecting true tissue damage or illness.

> *Cause like right now I have pain like right here. Right in my femur. It's just like an ache. And I know I didn't do anything to that, right? So, I just know it's something like my body is doing. So that's another thing where you're like okay, could this be my – could this be a tumor or could this be this? And it's just like a constant like, 'oh! Is my brain doing this or is like actually something or did I hurt it?'* – P6, Osteosarcoma

Although several sensations were described in such terms, pain was commonly identified as a sensation infused with uncertainty. One participant highlighted that pain, as compared to other sensations, is particularly difficult to interpret and to tie to a probable cause.

> *Pain on the other hand is like, it's a little more anxious feeling because, am I having pain because the body is so complicated? Or am I having pain cause of this or this or this? Or is it something that I don't know about?* – P19, AML

Several participants discussed self-enforced rationality as a strategy for coping with the inherently uncertain nature of post-cancer somatic sensations. P5 described some respite in considering that their symptom could be attributed to a less threatening health problem (i.e., the common cold). This suggests that some survivors may find it helpful to receive preemptive guidance towards alternative explanations for common, everyday symptoms from their survivorship care team (e.g., 'cancer survivors get colds, too').

It's every time even in smaller things that thought is still there to a certain extent but I just – I feel like I have to look at things like realistically and be like, 'oh do I have lung cancer or do I just have a little bit of a cold?' – P5, Ewing Sarcoma

Several participants stated that despite feeling anxious about a new symptom, they did not reach out to a doctor because they were not sure if their anxiety was warranted. While for some the decision to not contact the healthcare team appeared relatively straightforward, others described this decision-making process as a source of turmoil and conflict. This sense of conflict again seemed to align with a 'better safe than sorry' approach to interpret even likely-benign sensations as threatening, as exemplified by the following participant who claimed the following when asked if they ever consult their oncologist:

I don't think it's that serious to tell her but at the same time I'm panicking because I think it's serious. I don't know. I'm drawing the line somewhere in my mind. I'm contradicting myself in a way that I – now that I think back on it, it's weird. I just thought it that it was not that serious but at the same time it's just very real to me at the moment. Cause I thought there was an understanding somehow that I knew it was probably not – at the same time I'm very anxious. – P10, Ewing Sarcoma

Other particiapnts described instances where symptom-related concerns had sparked healthcare-initiating behaviors and, in some cases, additional medical surveillance; this provides preliminary evidence indicating that the way childhood cancer survivors interpret symptoms can directly influence and increase healthcare utilization. Relatedly, some participants described that their symptom would disappear following reassurance, indicating that threat interpretations may serve to maintain the presence or salience of sensations themselves.

> *I was really scared about [pain in my foot] but then we went and got it checked out and they said it was nothing and then like the pain went away.* – P23, Osteosarcoma

Understandably, while some participants described feeling relief in deciding that sensations were more likely 'in their head' than signaling cancer recurrence, the opposite appeared to be true for late effects. That is, some participants described relief in receiving evidence or validation that certain symptoms *were* a result of treatment rather than something they had 'made up'. This indicates that different strategies may be more or less useful to promote coping depending on whether the symptom is interpreted as indicating a recurrence or a late effect of treatment.

> *I think it's really kinda like frustrating cause you're just like, is it in my head? Am I inventing this feeling? […] I felt so, like affirmed when I think like some other patient who like had, chemo several years ago was like, 'oh no it's totally real, like even small things' […]. Then I was like, 'oh okay maybe I'm not just psycho and like there's actually something going on here'* – P12, Non-Hodgkin Lymphoma

Finally, although symptom-related uncertainty was salient for many of the participants, some described that their sense of uncertainty reduced across the survivorship trajectory, pointing towards a positive outlook. The building of greater certainty in symptom appraisal over time can

be understood within the extant literature indicating that survivorship represents a 'new normal' for those living beyond cancer (Appleton & Flynn, 2014; Trusson, Pilnick & Roy, 2016).

> *I'm used to my new normal now or I'm used to, you know, the symptoms I'm feeling. I know how to deal with it. I know what's normal and what is concerning. Cause that's a huge thing that, you know, cancer survivors have to figure out. […] I'm very in tune with what's normal for me. But learning what's normal has been a process, right?* – P4, Brain Tumor

This third and final theme captures a critical issue that lies at the core of symptom appraisal that is relevant for those living beyond cancer and other chronic health conditions. Uncertainty underlies the need to make sense of all changes in bodily state, yet it is particularly salient in the context of an ambiguous and life-changing health threat. In cancer survivorship, as in other diseases with a relapsing-remitting pattern (e.g., irritable bowel disease, multiple sclerosis), the individual must make sense of changing somatic sensations within the broader context of living in a state of health purgatory, ever betwixt and between 'healthy' and 'sick' (Rees, 2018).

DISCUSSION

Making sense of somatic sensation is a critical challenge when navigating a current or possible illness. Using a hybrid deductive-inductive thematic analysis with in-depth interview data, we generated novel insights into the process and influence of somatic sensation perception within a salient context of health-related uncertainty: childhood cancer survivorship. Our analysis yielded three core themes. These themes revealed that participants described commonly interpreting somatic sensations as indicating cancer recurrence or new illness (theme 1: symptoms as signals of bodily threat) and a felt need to monitor and assess changing somatic sensations during survivorship (theme 2: playing detective with bodily signals). These first two themes can be understood within participants' broader recognition that post-cancer symptoms are wily, difficult

to interpret, and often influenced by psychological factors such as anxiety (theme 3: living with symptom-related uncertainty). Across the three themes, we identified how participants' symptom appraisals were influenced by clinical practice (e.g., clinician-directed self-monitoring) and subsequently influenced healthcare utilization (e.g., contacting the oncology team and seeking additional tests). Thus, our findings indicate that the way individuals interpret and respond to somatic sensations within an uncertain health context is interrelated with healthcare provision.

Our findings build on previous studies in cancer survivor populations. In particular, quantitative studies have indicated that somatic sensations such as pain and fatigue are common after cancer (Pachman et al., 2012) and are associated with higher fear of cancer recurrence (Kelada et al., 2019; Simard et al., 2013) and reduced quality of life (Huang et al., 2013). Our qualitative data indicates one reason *why* post-cancer symptomatology may exacerbate psychological distress – because it triggers fear of cancer recurrence or treatment sequelae. These findings replicate another recent qualitative study with childhood cancer survivors (Tutelman et al., 2019) and indicate the need for validated measures that capture individual differences in the extent to which survivors perceive somatic sensations as indicative of bodily threat. Qualitative data are well suited to guide new new measurement development, particularly by revealing patient-centric language than can be directly translated into measurement items. Studies that capture the dynamic nature of symptom appraisal and health-related fears over time, including Ecological Momentary Assessments (EMA), will also be helpful to expose the symptom-distress relationship.

Our findings also build on the well-established study of cancer symptom clusters (Fan et al., 2007). Individuals living with and beyond cancer can experience an array of co-occurring symptoms (e.g., pain, fatigue, sleep disturbance), and the targeting of these clusters through intervention is yielding promising results for reducing symptom burden and improving quality of

life. Tentatively, our findings suggest that a general tendency to interpret somatic sensations as signals of bodily threat could act as a mechanism maintaining symptom co-occurrence in this population through a process of increased body vigilance, perceived need for protection, and somatic windup; this hypothesis warrants empirical investigation.

Our findings should also be situated within the broader study of uncertainty and risk perception in healthcare. Uncertainty in illness has been a central feature of health psychology research for several decades, situated within core theoretical frameworks (Mishel, 1988). Illness-related uncertainty and appraisals have emerged as key factors associated with child and parent adjustment in childhood cancer (Fortier et al., 2012; Mullins et al., 2016; Szulczewski et al., 2017). In both child and adult survivors of cancer, this uncertainty appears to be a significant corollary of both somatic symptoms and quality of life (Cahill et al., 2012; Fortier et al., 2012). In a qualitative study, Rees (Rees, 2018) described adult cancer survivors' experiences of uncertainty as a state of 'embodied risk', thereby illuminating fear of cancer recurrence as an embodied experience and again providing credence for the fruitful study of symptom appraisal as a trigger of fear of recurrence. Beyond oncology, perceived uncertainty is shown to have strong relationships with somatic symptoms and quality of life in those undergoing 'watchful waiting' for diseases such as chronic hepatitis C (Bailey et al., 2009). Since the advent of precision medicine and genetic testing, there are emerging necessities for understanding how symptoms are perceived and responded to as signals of bodily threat within this new and uncertain context. For example, how does knowing one has an inherited vulnerability for disease influence one's mindset about their body, their interpretation of ambiguous somatic sensations, and resultant healthcare behaviours? Helping individuals cope with symptom-related uncertainty may be an important addition to genetic counselling. Given our findings that participants often anchored their symptom interpretations on

their initial diagnosis and treatment, it will be helpful to use similar qualitative methods to understand how individuals appraise symptoms without a personal experience on which to anchor those appraisals.

Finally, our findings have implications for clinical practice. Several participants identified that the healthcare team played a role in their symptom monitoring practices, whether via explicit instruction to engage in symptom self-monitoring or via enquiring about symptoms at surveillance visits and thus implicitly (and likely inadvertently) triggering a perceived need to be vigilant for these symptoms. It will be helpful to further explore, through qualitative and quantitative studies, how and to what extent the healthcare team has an influence on symptom appraisals through how they counsel patients, whether they could decrease distress by discussing the likelihood of various symptoms heralding recurrence, and whether certain approaches by healthcare providers encourage or discourage contact from patients about symptoms of concern. Normalizing symptom-related concerns as a typical post-cancer experience could usefully be offered as anticipatory guidance to individuals finishing cancer treatment (Heathcote et al., 2018). Relatedly, participant experiences particularly captured in the third theme ('living with symptom-related uncertainty') point towards the broader need to validate symptom-related concerns during survivorship. While the healthcare team will be one source for such validation, some participants described relief upon hearing that peers who had also completed childhood cancer treatment experienced similar symptom-related concerns. Thus, our findings point towards the valuing of both medical and experiential knowledge in offering validation for post-cancer symptom experiences.

This study has limitations, pointing towards future research directions. First, we over-sampled certain diagnostic groups. Future studies would benefit from targeting other groups (e.g., central nervous system tumors) to understand their unique experiences and ensure that future

evidence-based interventions can meet their needs. Second, although our sample was more ethnically diverse than previous studies (Tutelman et al., 2019), certain minority groups, particularly African Americans, were underrepresented. Finally, while our theory-driven approach afforded a unique insight into theory-relevant processes, we have likely missed insights that would have stemmed from an entirely inductive approach. For example, as the CTI model is largely intrapersonal, our analyses did not reveal a significant role of parents that was observed in a previous study (Tutelman et al., 2019).

Living with risk for a new or recurrent health condition is a context permeated by uncertainty. Here we present an in-depth exploration of one facet of this uncertainty, specifically that of symptom appraisal. Our findings are relevant not only for understanding cancer survivorship but also symptom perception within any uncertain health context. In particular, our theory- and person-centered analysis yielded findings that can help move our understanding of symptom perception from a biomedical perspective (symptoms as markers of bodily state) towards a functional-motivational perspective (symptoms as signals of bodily threat). They may also help move us from viewing persistent somatic symptoms as an abnormal psychosomatic manifestation of distress, towards a normal response to a credible health threat (Heathcote, 2019).

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